ON THE

GROWTH OF THE RECRUIT

AND

YOUNG SOLDIER,

WITH A VIEW TO

A JUDICIOUS SELECTION OF "GROWING LADS" FOR THE ARMY, AND A REGULATED SYSTEM OF TRAINING FOR RECRUITS.

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TO

THE RIGHT HONOURABLE

SIR GEORGE CORNEWALL LEWIS, BART., M.P.

Secretary of State for War,

&c. &c. &c.

CONSPICUOUS
DURING A LENGTHENED PERIOD
OF PUBLIC SERVICE,
NOT LESS FOR ADMINISTRATIVE ABILITY, THAN FOR HIGH
ATTAINMENTS IN LITERATURE AND SCIENCE,
AND FOR ENLIGHTENED OPINIONS REGARDING THE
IMPORTANCE OF ACQUIRING A KNOWLEDGE
OF THE BEST METHODS OF OBSERVATION AND REASONING
IN POLITICS,
EQUALLY APPLICABLE TO THE SCIENCE OF MEDICINE,
THESE PAGES ARE (BY PERMISSION)

Respectfully Dedicated.

PREFACE.

THE following pages embrace the topics of two lectures, introductory to the Practical Courses of Instruction at the Army Medical School, delivered at the opening of its fourth session, in April last.

Divested of technical terms in its treatment, the subject was believed to be of sufficient importance to warrant publication in a form that might be useful and suggestive to those who have to do with recruits and young soldiers; and at the request of Major General Eyre, commanding the garrison at Chatham, it is

now published, amplified to some extent in detail, but retaining the form in which, as Lectures, the topics were originally put together.

Those who have to do practically with the Recruit in teaching him military duties and drill, and in pressing him forward to fill up voids in the ranks within as short a time as possible, do not sufficiently regard the physiological constitution of the "*growing lad*," nor the nature of his skeleton framework as the material they have to deal with in training him.

The principles (physiological?) which have hitherto guided the military authorities in the selection of Recruits appear to be unsound:— (1) as regards the co-relation of *age* and *height*; and, (2) as taking no cognizance of *weight*, *development*, *bulk* or *growth*, in their relations to *age* and *height*. The result is, that teaching the recruit his military duties and drill, and taxing him prematurely with the routine duties

of the soldier's life, eventually lead to the discharge of a proportionally large number of young soldiers, before they have been three years, or even two years in the service; and the greater portion even of these two or three years is spent in hospital. Any part of an army composed of such material, can never constitute a very formidable phalanx; and the *service* of such soldiers represents merely a *nominal* strength.

The result of such injudicious selection of "growing lads" and, still more so, the ill-regulated exercise of them, in place of their being systematically trained, tends to encumber the military hospitals in the first instance; and if military duties and drill do not lead directly to the premature death of the young soldier, they sooner or later lead to his being discharged from the army as unfit for a soldier's duty. Thus, he is thrown out of the service, and becomes a burden upon the civil population,

with one or more of his vital organs damaged for the remainder of his life.

For the military service of Great Britain, the recruit is a volunteer. He chooses to be a soldier. He selects of his own free will an employment in which he may thus break down at an early period in the hands of the drill sergeant, who, with the best intentions, tries to make him a soldier sometimes within sixty days, when he is considered fit to endure the fatigue and the labour of active military service at home or abroad—a service in which he may be led to suffer the pains of wounds, to toss on a fever-bed in the camp-tent, or the hospital ward, or even to die on the battle-field.

In accepting services thus so freely offered, it is surely alike the duty and the interest of the nation to place the recruit under such conditions as are the best possible for rendering his life fully available and profitable to his country.

Considered merely in a money point of view (if, as is calculated, a soldier costs the country £100 a-year), it is worth some care and trouble to train him efficiently and economically, which can only be done by keeping him in good health and condition during the period of training, and conducting such training according to a well-regulated system, based on the established truths of physiology.

Apart, therefore, from motives of humanity —generally the first to arouse sympathy and to initiate action—the main object of the following pages is to demonstrate the "growth of the recruit and the young soldier," with a view to suggest a judicious selection of "growing lads" for the army, and a regulated system of training recruits. It must be admitted that the subject is one which immediately concerns the health, the wealth, and the military strength of a nation; and I would claim, at least for the recruit, the exercise of a

judgment in selecting him not less sound, and of a care in training him not less scientific, than the judgment and the care which a gentleman thinks judicious and proper to bestow upon a useful dog or a valuable horse.

Fort Pitt, Chatham,
July, 1862.

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LECTURE

INTRODUCTORY TO THE COURSE OF INSTRUCTION

AT

THE ARMY MEDICAL SCHOOL.

SPECIAL VOCATION OF THE MILITARY MEDICAL OFFICER.

Colleagues and Gentlemen,—I am about to address myself to those young men who are candidates for commissions in the Medical Service of Her Majesty's British and Indian Armies; and to those Medical Officers who have joined the courses of instruction here.

Some of you have but recently left the schools of Medicine, where you have studied and acquired a competent knowledge of the principles of your Profession, and where you may have had some experience of its practice. It has been ordained, nevertheless, that you should attend

certain courses of instruction at the Military Hospital for Invalids at Fort Pitt, in order that you may become practically acquainted with your special duties as Army Surgeons.

Although we thus stand to each other in the relations of the "teacher" to "those taught;" yet on my part, and I am sure also on the part of my colleagues, we desire to meet you as brethren in the same Profession, to work together in the same field of labour, as earnest students ought to work, whose common object is to observe and to study the diseases incident to military life in every region of the world. We desire to investigate together, according to the best methods, the *nature* and the *causes* of those diseases, so that we may learn to put in practice the most *efficient means* for their *prevention* and *cure*.

The objects contemplated by Government in thus providing courses of instruction for you at this place are, not only to give you a practical acquaintance with the specialities of Military Medical life, but to teach you *more especially* all that relates to the prevention of disease amongst soldiers.

In some respects, therefore, the routine busi-

ness of your Profession as Military Medical Officers will differ somewhat from that of your Professional brethren in civil life. The laborious and benevolent vocation of the latter is to cure the diseased, and to heal the sick; for "they that be whole need not a physician, but they that are sick."

On the other hand, the great aim and object of your life as Military Medical Officers, is to prevent sickness and loss of strength amongst the soldiers committed to your care; and, to carry out a little further this view of regarding your special functions, it may be held that every case of *preventible disease* among soldiers which is brought to you for treatment, is a living witness that you have failed in the special object of your vocation. If, unfortunately, indeed, the soldier should die, he may not justify the proverb, that "dead men tell no tales;" for the records of the post-mortem examination may suggest to you, and to others after you, that death left upon that soldier a "stamp" of the existence of preventible disease—such "stamps" as one may see in the Museum of Pathology at Fort Pitt. The post-mortem record may also show that the *prevent-*

ible disease which killed your patient was not the only one from which he had suffered during a lengthened period of service. It may be that the "stamps" of diseases contracted years before his death were still apparent, and accorded with the Medical history of his life. These diseases may have impaired his constitution, and rendered him a more easy victim to the malady from which he died.

On the other hand, again, you are fairly entitled to reason from the converse view of all this, and to claim for yourselves the merit of success if the sickness, the loss of strength to the service, the invaliding and mortality, are below the average, and continue to diminish or to disappear altogether amongst the troops while they are under your care. You have at once an instance of this form of argument, and an authority for its use, in the speech of the Right Hon. the Secretary of State for War in moving the Army Estimates for the current year in the House of Commons :—

"Improvements," he remarks, "have been introduced with a view to ameliorate the social, moral, and sanitary condition of the private soldier. Much expenditure has been incurred

for the sake of enlarging and improving Barracks, and in carrying out various recommendations of the House of Commons, with respect to Barracks and the Hospitals connected with them. I am happy to say," continues the Right Hon. gentleman, "that these efforts have not been unattended with important results, as will appear from authentic returns of the mortality in the service. These returns have been prepared by the Director-General of the Army Medical Department, and I believe they are perfectly authentic, though it is certainly difficult to believe that so great a change can have taken place in so limited a period. It is possible that the greater youth of some portions of the Army may, to a certain extent, affect the returns, but I believe the difference is mainly to be explained by improvements in the sanitary conditions under which they are now called on to serve.

Deaths among the Troops serving in the United Kingdom annually per 1,000 *of men.*

	From 1830 to 1836.	1859 to 1860.
Generally throughout	14	5
Cavalry of the Line	15	6
Royal Artillery	15	7
Foot Guards	21	9
Infantry of the Line	17	8

Similar Returns for the Colonies are as follows :—

	From 1837 to 1856.	1859 to 1861.
Gibraltar	22	9
Malta	18	14
Ionian Islands	27	9
Bermuda	35	11
Canada	20	10
Jamaica	128	17
Ceylon	74	27

"I have other returns from other colonies," continues the Right Honourable gentleman, "and I believe that these returns are authentic, and certainly they show how very considerable a diminution has taken place in the mortality of the Army, and these results are very encouraging for future attempts in the same line of improvement."*

The Art of Medicine, guided by Sanitary Science, must now, therefore, be regarded as a productive Art ; for by diminishing the occurrence of preventible disease, and thereby lessening mortality, the average duration of human life has been extended to an age nearer that which has been ordained for man. In this respect, therefore, the labours of the Medical Officer, either in civil or in military life, cannot

* See *Times*, March 4, 1862.

be regarded by the political economist as unproductive labour.

But while we thus take so strict and rigid a view of the special functions of the Medical Officer to whom the *health* of armies is entrusted, it must, at the same time, be generously remembered that we can only aim at a perfect success, never to be attained even with our best endeavours.

We must remember that the sphere of our Professional exertions is limited, and surrounded by insurmountable barriers; and that death will eventually come alike to all, sooner or later—to the Surgeon as well as to the Soldier—"reminding us that we ourselves must become victims to the incompetency of our art."

SCOPE OF THE SPECIAL INSTRUCTIONS AT THE ARMY MEDICAL SCHOOL.

The practical view which you are required to take of your Profession is, that "Medicine is the art of understanding the nature of diseases, so as to appreciate their causes, and to prevent their occurrence when possible; to promote their cure, or to relieve them when they occur."

At one end, therefore, of the scheme of study chalked out for you during the short period of your residence at the Army Medical School, the Science of Hygiène stands pre-eminent and paramount; at the other extreme is the Science of Pathology. Between these two extremes you have the clinical study of diseases which have been contracted in various regions of the world, as well as of wounds and injuries. The cases of these diseased, wounded, and injured soldiers are most instructive, and they are

treated in the wards of the Hospital, under the direction of the Professors of Military Medicine and of Surgery; who will each instruct you also in the specialities of Military Surgical practice, and in the peculiar characters, course, and treatment of Tropical Diseases.

I will not further occupy your time by any attempt to explain in detail the plan and the scope of the special instructions which my colleagues have prepared for you in the discharge of their several duties as Professors. They will each do this when they meet you for the first time in this lecture-room. Let me rather proceed at once to open up the subject with which we are together more immediately concerned, namely:—

PATHOLOGY.

The short duration of our courses of instruction permits me to accompany you but a very little way in this great field, and ultimately, indeed, I can only indicate the road through which it is most reasonable to believe that the greatest advances in the science of Medicine are to be effected. The belief is now rapidly

gaining ground, and acquiring even a hold on the popular mind, that advances in the science of Medicine in future years will be mainly due to "a better appreciation of the causes of disease." And just in proportion as our knowledge of physiology and pathology becomes more exact and extended, so will the "causes of disease" be appreciated, and the "occurrence of diseases" on a large scale will be prevented.

An amiable and large-minded Physician, who but recently has taken his place among "the great ones of the Past,"—I mean Sir John Forbes—observed and emphatically recorded more than fifteen years ago, that "here the surest and most glorious triumphs of Medical Science are achieving and are to be achieved." He himself lived to see great and good results, which continue to be realised.

"Improvements in social and sanitary matters have, indeed, made rapid progress of late. Within the last half-century, land draining and town sewering have ripened into sciences. From rude beginnings, insignificant in extent and often injurious in their effects in the first instance, they have become of the first

importance. Land has, in many instances, doubled in value; and town sewering, with other social regulations, have not unfrequently prolonged human life from 5 to 50 per cent., as compared with previous rates in the same district."

"Agues and typhoid fevers are reduced. Since 1840, an annual mortality in English towns of 44 in 1,000 has been reduced to 27; an annual mortality of 30 has been reduced to 20, and even as low as 15; and human life has now more value in England than in any other country in the world—a result entirely due to better sanitary arrangements."* The political economist must therefore regard Medicine as a productive art.

The science of physiology, however, has immeasurably outstripped that of pathology in the comprehensiveness of its views and in the value of its results. Pathology, in its turn again, has always been and ought to be in advance of therapeutics. It is in the nature of our science that it should always be in advance of treat-

* On the Sewering of Towns and Draining of Houses. Robert Rawlinson, Esq., C.E., F.G.S.—*Journal of Society of Arts*, March 21, 1862, vol. x. p. 276.

ment. Pathology, indeed, is the basis of rational medicine; for it is rational to know the nature of a disease, in order (1) to enable the Medical Officer to prevent it, and (2) to enable him to understand the principles which ought to guide him in its treatment to a successful issue.

The best physiologists have distinctly recognised, that the basis of their science must include not only a knowledge of animals below man, but a knowledge of the entire vegetable kingdom. Without such an extensive survey of the whole realm of organic nature, we cannot possibly understand human physiology, and far less comparative physiology. Our science, therefore,—*that of Pathology*,—which deals with "the nature of diseases," must be, *a fortiori*, very far behind.

The diseases of the lower animals, for instance, rarely form any part of our study. The diseases of plants are almost entirely neglected by us. Yet it is clear, that until all these have been studied, and some steps taken to generalise them, every conclusion in pathology, regarding the nature of diseases, must be the result of a limited experience from a limited

field of observation. How do we know that the blights of plants, or the causes of them, are not communicable to animals and to man? We know how intimately related the diseases of man and animals are with famines and unwholesome food; and of famines with the diseases of vegetable and animal life, as much as with the destruction and loss of food.

To physiology, therefore, in its most comprehensive sense, and to a knowledge of the natural and normal development of animal and vegetable beings, we must look for future progress in pathology; while the means and the instruments which advance physiology will simultaneously advance our knowledge regarding the "nature of diseases;" and a true knowledge of the nature of diseases can alone enable us to "appreciate their causes," and so arrange "*measures for their 'prevention,'*" based on the great truths of science.

Let me now show how the science of physiology, and a knowledge of the development of the human body, may enable us to appreciate the "*nature and the causes*" of some of those diseases to which the loss of strength of a very large proportion of our soldiers may be traced.

GROWTH OF THE RECRUIT AND THE YOUNG SOLDIER.

First, let me turn your attention to the *growth of the recruit;* and when we consider fully the details to which I am about to direct your study, you may, perhaps, appreciate better the value and importance of the instructions which will be given you by the Professor of Hygiène, regarding the *physical training* most proper for the young *soldier*,—a training which, while it tends to develop his strength commensurate with his growth and with his years, tends also to preserve him from disease, and fits him most efficiently to learn and to endure the labour of military duties and drill.

In the Statistical Report of the Army Medical Department for 1859, it appears that there were 16,553 soldiers *under* twenty years of age, and that there were 40,389 men under twenty-five years of age, and 52,041 soldiers under thirty years of age. These numbers

include home and foreign stations. Now, if you look to the loss of strength in the army as represented by the number of invalids passing through this Hospital in any one year, it has been found that upwards of 16 per cent. are recruits under *two* years' service; and that the greater portion of that time had probably been passed in Hospital. The diseases for which these young men were discharged the service were chiefly (1) pulmonary disease, and (2) heart diseases, (3) epilepsy and diseases of the nervous system, and (4) diseases of the bones and joints. Dr. Balfour's Report also shows us that the deaths among newly-raised men, (as in the dépôt battalions and the second battalions) are greatly in excess of those in the older regiments; an excess of mortality chiefly owing to pulmonary diseases, diseases of the circulation, and of the nervous system.

During the past year upwards of 34 per cent. of those invalided for tubercular diseases had not served three years; upwards of 44 per cent. of those invalided for heart diseases and diseases of the circulation, had not served three years; upwards of 47 per cent. of those invalided for epilepsy and diseases of the

nervous system, were also under three years' service.

To appreciate some of the causes which may be producing and maintaining such losses of strength and mortality, I would call your attention to the *physical growth of the recruit and the young soldier* as demonstrated by the tables and woodcuts which follow, and by the condition of *four* skeletons from the museum, which fairly represent the framework of the human body at ages under thirty years,—namely, one at the age of sixteen; a second at the age of more than seventeen, but less than twenty; a third at the age of more than twenty, but less than twenty-five; and a fourth at twenty-five.

Physical growth and *development* are in the greatest perfection when there is a due concurrence between *age*, *weight*, and *stature*. The due concurrence of these three conditions is the best evidence we yet possess of normal and healthy physical development and growth, and physical maturity is of unquestionable importance with reference to the military strength of a nation.

Now, the elements of *stature* and the *age* of

recruits fall peculiarly under the superintendence of the *military authorities*. They may form an army composed of men at any age and of any height which can be obtained; while questions connected with *the maintenance of health* and of *general physical efficiency* of the soldier, both individually and collectively, are for the decision and consideration of the *Medical Officer*.

According to the existing army regulations, soldiers are not entitled to reckon service under 18 years of age as a claim for pension; consequently, recruits have some inducement to state that they are 18 years of age when they are not.* Provided then that a young man has attained the *minimum* height authorised by the *military department* as the stature at which he may be enlisted, if he is seen to be a "growing lad," (however young he may be), the recruiting officer rejoices to get him. In fact, the term "growing lads" characterises the article which is advertised for, when recruits are in demand, and the recruiting officer has been known to enlist them when they were even under the required stature. At one time

* Marshall on Enlistment.

(1804), indeed, a premium of £2 2s. was allowed to parents who brought a boy under 16 years, but who was then five feet two inches in height.*

It is now known that age, weight, development, and strength are very closely co-related; and their due proportions are absolutely necessary to be maintained in order to enable a soldier, or any other living being, to go through the fatigues and the hardships incident to a military life. *Age* is only *one* of *three* most important elements; and when the bones of the skeleton are examined and the following tables studied, it will appear that up to the age of thirty years, the skeleton framework of the body is still growing, and that the whole man is only arriving at maturity. Such a study ought to convince any one of the necessity of great care and caution in handling young men or young animals, in order that they may be trained with success without inducing disease. At eighteen years of age many recruits are but slim lads, who have not yet attained their full height, bulk, or development, and whose bones have not nearly

* Marshall, loc. cit.

completed their growth. To load him therefore with weights, and to expect him to go through the same work as a soldier of thirty years of age, is to expect more than human nature can endure with impunity.

In directing attention to the following table, I will simply say that it is remarkable for its completeness and its accuracy. That great care has been taken to record the observations justly, "the height and weight having been taken with apparatus constructed for the purpose by well-known makers. The height and the weight were taken at the same time, in the same place, and by the same person. Thus, the observations were always taken in the same way, and by the same officer, whose character, intelligence, and long practice afford a strong guarantee for the general accuracy of his work."*

The reader may also compare the data in the following table with those given in Addenda I. by Dr. Liharžik; and with those given by Dr. Boyd in the Royal Society's Transactions, 28th February, 1861.

* *Statistical Society's Journal*, March, 1862, page 22.

Growth of the Human Body from 18 *to* 30 *years of age, indicated by weight and height; averages taken from* 100 *observations and upwards at each age. Records taken from observations upon* 4,800 *Criminals at all ages.* (*Statistical Society's Journal, March,* 1862, *by J. W. Danson.*)

Age.	WEIGHT.									HEIGHT.								
	Average.		Maxim.		Minim.		Maxim. over Aver.		Minim. und. Aver.		Maxim. over Min.		Average.		Maxim.		Minim.		Maxim. over Average.	Minim. under Average	Maxim. over Minim.
	Stones	Pounds	Stones	Pounds	Stones	Pounds	Stns.	Pds.	Stns.	Pds.	Stns.	Pds.	Feet	Inches	Feet	Inches	Feet	Inches	Inches.	Inches.	Inches.
18	8	10·79	10	13	6	6	2	2· 2	2	4·79	4	7	5	4·34	5	11	4	10½	6·66	5·84	12½
19	9	4·11	12	8	7	4	3	3·89	2	0·11	5	4	5	4·94	5	11½	4	11	6·56	5·94	12½
20	9	5·58	12	8	7	13	3	2·42	1	6·58	4	9	5	5·11	5	11	5	1	5·89	4·11	10
21	9	5·02	12	0	7	3	2	9·	2	2·	4	11	5	5·57	5	11¼	5	0½	5·68	5·07	10¾
22	9	12·41	13	2	7	0	3	2·59	2	12·41	6	1	5	6·17	6	1	5	0¼	6·83	5·92	12¾
23	10	2·95	12	12	7	12	2	9·05	2	4·95	5	0	5	6·17	6	1	4	11	6·83	7·17	14
24	10	2·	12	12	7	12	2	10·	2	4·	5	0	5	5·94	6	1	4	9	7·06	8·94	16
25	10	5·65	13	8	8	2	3	2·35	2	3·65	5	6	5	6·30	6	0	4	11	5·77	7·30	13
26	10	1·06	13	8	6	12	3	6·94	3	3·06	6	10	5	6·28	6	1¾	4	9½	7·07	8·78	16¼
27	10	4·75	13	10	7	12	3	5·25	2	6·75	5	12	5	6·38	5	11¾	5	1	5·37	5·38	10¾
28	10	2·62	13	2	7	7	2	13· 2	2	9·62	5	9	5	6·65	6	1	5	1	6·35	5·65	12
29	10	5·53	13	12	8	4	3	6·47	2	1·53	5	8	5	7·02	6	0¼	5	1¼	5·48	5·52	11¼
30	10	1·55	14	1	8	1	3	13·45	2	0·55	6	0	5	6·36	6	1	5	0¾	6·64	5·51	12¼

From this table it appears that a young man who has reached the average height at eighteen years of age, may still be expected to grow more than two inches *before he is fully developed.* He will then be of a bulk (supposing him to be 146 lbs. weight,) sufficient to displace at least 150 lbs. of water=2·604 cubic feet. Farmers and trainers of race-horses are now beginning to understand the importance of attending to the due concurrence of age, weight, and development in the training of horses, and other animals.

The advice of an eminent professor of veterinary pathology (Varnell) on this important subject to the students of his college, is characteristic of progress:—"As men of science," he says, "you ought to point out the folly caused, and the deterioration and suffering induced by training and running horses at an age long before they arrive at maturity. Many are trained when not more than a year and a-half old, and a large proportion of them are thereby lamed for life. Their joints become diseased, their ligaments and tendons strained, and their bones and the membranes covering them inflamed. In this condition they are placed in

the hands of the veterinary surgeon, very often with a peremptory order to fire and blister the affected limbs. Instances are not unknown, where only one leg is affected, for a request to be made to fire the opposite one also, on the supposition that it would be strengthened by the operation. If the suggestion is acted on, the poor animal's legs are cauterized with the hot iron, and he is again handed over to the trainer. Such a horse might stand training, but in all probability he would break down the first race he ran."

So it may be with the young soldier, and so it *has been* with him, as the pages of history duly record.

As to Age.—Experience has taught Continental states that men are in general not able to surmount the fatigue of a military life under twenty years of age.*

It is clear, also, that the recruit ought not to pass into the ranks of the army much below that age. Probation for judicious training is necessary to enable the recruit to develope his strength and learn to husband it, so as to surmount the fatigue of military duties. "Recruits,

* Marshall, loc. cit., page 8.

at eighteen years of age," says M. Coche, "are commonly unfit for the duties of an army. If they do not possess unusual strength, they pass two, three, or even four years out of eight years' service in the hospital if they are not discharged the service altogether before that time."*

Sir James McGrigor records that corps which arrived for service in the Peninsula were always ineffective and sickly in proportion as they were made up of men who had recently joined the ranks; and, in making calculations for measures in the field, 300 men who had served five years were more effective, and more to be depended on than a regiment of 1,000 men who had just arrived, and who were young recruits, —lads unequal to the harassing duties of service,—an experience, he says, which is still more true regarding India.†

Many examples are also to be found in the records of our Russian experience in 1854, which show that young and "growing lads" are much less able to endure the fatigue of marching than mature men. When the Duke of Newcastle informed Lord Raglan that he had

* Marshall, loc. cit.

† Med.-Chir. Trans., vol. vi.

2,000 recruits ready to send to him, he replied that "those last sent were so *young* and *unformed* that they fell victims to disease, and were swept away like flies. He preferred to wait."*

Sir De Lacy Evans states in the same Reports† that the drafts sent to him were composed of men too young.

H.R.H. the Duke of Cambridge tells us‡ that the young men suffered twice or three times as much as the men who had been there all the time.

General Viscount Hardinge § also bears testimony to the fact that many men were sent out to the East as a reserve who were young recruits; and he further states, (as if it were an achievement to be imitated as an example,) that these young recruits were made perfect in drill in the course of *sixty days;* and although he states that no men were sent out under nineteen years of age, yet, when sent out, it was found that instead of being composed of bone and muscle, they were almost gristle. In fact, he says, they were too young; yet he, nevertheless,

* *Fifth Report on Army before Sebastopol.*

† Loc. cit., Question 755. ‡ Loc. cit., Question 4,204.

§ Loc. cit., Question 20,773.

seemed to think that limiting the age to nineteen was a restriction in the power of sending out men. Moreover, Lord Hardinge was of opinion that in two months, or sixty days, a man could be trained into a very good soldier. Such had been done in the Peninsula. "Give us," he says, "a good stout man, and let us have sixty days to train him, and he will be as good a soldier as you can have." This may or may not be the case as regards mature men. It certainly cannot be done with impunity as regards "growing lads" under twenty years of age. If in the given time the lad may be perfect in his drill, the other contingency seems lost sight of, and Mr. Cobden in his recent very able publication—*The Three Panics*—while he quotes this dictum of Lord Hardinge, overlooks the fact that in *sixty days* the young recruit may break down so completely under the exertion, that before two more years pass over his head, he may be a dead man; or, having spent most of that time in hospital, he may be discharged the service on account of cardiac or pulmonary disease, and thus become a permanent burden on the civil population during the remainder of his miserable existence. Sixteen

per cent. of those invalided, we have seen, are discharged under these circumstances. Another fact must be here taken notice of, namely, that in all arms of the service up to the date of 30th October, 1854, the *standard of height* fixed* by the authorities at which "growing lads" might be enlisted, is *equal* to, and in some instances *above* the *average* height of the *mature human being*, as now accurately determined in this country by the observations of Dr. Robert Boyd, communicated to the Royal Society 28th February, 1861, and by the observations of Mr. Danson, already quoted. †

Examine now the *state of the bones* in the recruit and young soldier under twenty years of age, and when they have still to grow for ten years before they are mature.

In the very young state of the long bones, such as those which compose the arm and leg, the bone commences to grow in the middle of the shaft, and progresses in growth towards either end. The "principal piece" or *shaft* of the bone is thus first formed, and is known

* See Appendix 14, p. 353, to Select Committee on Army before Sebastopol.

† See also Addenda I, page 63.

to anatomists as the "*diaphysis*." Large portions at either end of this "principal piece" remain for variable periods of time in a soft, cartilaginous growing state, till at last separate and distinct points of bony growth appear in them also. They gradually become wholly converted into bone, and as bony processes they remain separated for a time from the "principal piece" by an intervening soft substance, which, for the time being, glues them to the shaft of the long bone. These superadded pieces are known to anatomists by the name of "epiphyses."

There are portions on the ribs, where they hinge upon the spine, which at the age of eighteen years have only commenced to grow from soft material into bone, and they are not completely turned into bone till the twentieth year of life. The ribs, therefore, are not fully grown till that age.

The accompanying woodcut of the last true rib may illustrate what is meant. The small thin bony pieces (2 and 3), which are superadded to the principal piece (1) of the rib, ultimately coalesce with it, and they are known to anatomists as "*Epiphyses*."

Fig. I.

The shaft of the arm-bone also (Fig. II.) continues to increase in length till the twenty-fifth year of life; and so long as this growth continues, a portion of soft, vascular, and growing tissue intervenes between the shaft and the head of the bone. It is not till about the twentieth year of life that this soft substance is converted into bone, and the principal bone of the arm is consolidated.

The lower end of the bone of the fore-arm, (Fig. III.), to which the hand is mainly fixed

Fig. I. One of the last true ribs; 1. The "*principal piece:*" 2. The thin bony piece superadded, and known as the "*Epiphysis*" of the "*head*" of the rib: 3. The thin bony piece superadded, and known as the "*Epiphysis*" of the "*tubercle*" of the rib. The growth of these superadded pieces commences between the sixteenth and twentieth years of life; and they coalesce (or become united by bone) with the principal piece of the rib about the twenty-fifth year of life.

at the wrist-joint, is also at the age of eighteen

Fig. II.

still incomplete; and it, too, is finished about the twentieth year of life.

Fig. II. The bone of the upper arm (Humerus). 1. The "*principal piece*" or shaft: 2. The piece of bone superadded, and known as the "*head*," or upper Epiphysis. It forms a part of the shoulder-joint, and coalesces (or becomes united by bone) with the shaft about the twentieth year of life: 3. The lowermost piece superadded, and which coalesces before the eighteenth year: 4. The innermost superadded piece, known as the "*internal condyle*," unites about the eighteenth year.

The lower end of the other bone of the fore-

Fig. III.

Fig. IV.

arm (Fig. IV.), unites about the nineteenth or twentieth year.

Fig. III. The bone of the fore-arm to which the hand is mainly fixed at the wrist-joint (Radius). 1. The principal piece or shaft: 2. The uppermost superadded piece, which coalesces with the shaft about the period of puberty: 3. The lowermost superadded piece, which coalesces with the shaft about the twentieth year.

Fig. IV. The other bone of the fore-arm (the Ulna.) 1. The "principal piece" or shaft: 2. The uppermost superadded piece coalesces about the sixteenth year of age: 3. The lowermost piece next the wrist-joint coalesces about the twentieth year.

Shortly after the twentieth year the head of

Fig. V.

the thigh-bone, which forms part of the hip-joint, unites to the shaft, and the end which

Fig. V. The thigh-bone (Femur). 1. Its "principal piece" or "shaft:" 2. The uppermost superadded piece, composing the "head," and forming part of the hip-joint, coalesces with the shaft about the twentieth year of age: 2 and 2″, are pieces superadded, which have joined at an

forms the knee-joint becomes united to the principal piece also.

The lower ends of the two bones of the leg at the ankle-joint also coalesce with the shafts between the eighteenth and twenty-fifth year.

Fig. VI.

Fig. VII.

earlier age: 3. The lowermost superadded piece, which takes part in the formation of the knee-joint. The bone is not completed by the coalescence of these parts till after the twentieth year of life; and the lowermost piece at the knee-joint is the last to join.

Indeed it is known, and the tabular statements, as well as a study of the skeletons, show that a great deal of growth goes on in different parts of the skeleton, tending to the development and perfection of the human frame, which cannot be regarded as mature till that age. The

Fig. VIII.

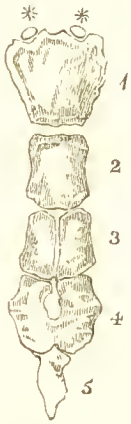

Fig. VIII.—The breast-bone (Sternum) composed of five pieces. The fifth piece coalesces with the fourth soon after puberty; the fourth coalesces with the third between twenty and twenty-five years of age; and the body or greater piece of the breast-bone is usually not completed by the junction of the third to the second before the 35th or 40th year. Lastly, the first division does not in general coalesce with the rest of the breast-bone at any period; but should its union take place, it is to be met with only in old age.—(*Quain's Anat.*, by Sharpey and Ellis, vol. i. p. 104.)

age at which each bone is complete is very different with different bones, and I have merely noticed the events in the growth of the skeleton which take place between the eighteenth and the twentieth years of age.

There are a great many very important bones still unfinished at the age of twenty, and which will not be consolidated till several years later. For example, the breast-bone still exists in several pieces. (Fig. VIII.) These begin to coalesce at the lower end of the bone.

The uppermost pieces of the leg bones are still, at twenty years of age, separated from their shafts by soft and growing cement. The pieces of the back-bone have also separate plates not yet soldered to their bodies. The bones composing the haunches are still incomplete. They are surrounded by rims of a soft substance, which, although it becomes bone, does not coalesce with the bodies of the haunch-bones till between the twenty-fifth and twentieth years of life.

Generally, also, it may be stated that all these superadded pieces may be separated from the bodies, shafts, or principal pieces of the respective bones by simple maceration in water

before coalescence has commenced. The soft cementing substance is thereby decomposed, and the several pieces fall apart.

Thus the growth of bone observes a distinct and definite order as to its beginning in each bone, and in each piece to be superadded to it; and the coalescence of these pieces with each other follows a definite order, as to time, in the respective bones which compose the skeleton.

So much indeed is this the rule, that, by a careful examination and comparison of the bones of a skeleton one with another at ages before twenty or twenty-five, a skilful anatomist is able to indicate with considerable accuracy the probable age of the individual; for the period of final coalescence of the several pieces which ultimately compose a bone is very different in different bones, and a tabular synopsis* of "events" in the growth of the skeletons during the military age may be of some value to the military medical officer, or to others interested in this subject, in appreciating the relation between age, development, and growth.

* The non-professional reader may pass over the following synopsis.

"*Events in the Growth of the Bones composing the Human Skeleton from the ages of* 16 *to* 30 *years.*" *Compiled from Records given by Quain, Sharpey, Ellis, Allen Thomson, Humphry, and other accurate Anatomists.*

(A. PERIODS OF GROWTH.)

I. FROM THE 16TH TO THE 17TH YEARS.

1. Epiphyses of spines and of the transverse processes of the vertebræ commence.

2. Epiphyses of the articular tuberosities of the lumbar vertebræ commence.

3. The pieces of the sacrum coalesce, commencing with the union of the body of the fourth to that of the fifth piece.

4. Epiphyses of the "heads" and "tubercles" of the ribs ossify.

5. First "centre" in the acromion process of the scapula, or shoulder-blade, begins to ossify.

6. Ossification commences in the lower angle of the scapula.

7. The second "centre" in the acromion process of the scapula grows.

8. The fifth and fourth pieces of the sternum, or breast-bone, begin to coalesce.

9. The epiphysal plate of the heel coalesces with the os calcis, or heel-bone.

10. Coalescence of ilium (haunch-bone), ischium, and pubis advances to completion.

11. The crest of the ilium (haunch-bone), the tuberosity of the ischium (or seat), and the pubic ramus, and the anterior inferior spinous process of the pubis begins to ossify.

12. The upper epiphysis of the ulna coalesces with the shaft.

II. FROM THE 17TH TO THE 18TH YEARS.

1. The lateral or auricular pieces of the sacrum grow and coalesce.

2. The styloid process of the temporal bone grows.

3. The base and shoulder-joint pieces (glenoid head) of the scapula are completed.

4. The sternal epiphyses of the clavicle ossify.

5. The lower epiphysis of the humerus unites with the shaft.

6. The epiphysis on the lesser trochanter unites with the shaft of the femur.

7. The epiphyses of the "head" and of the "tubercle" of the ribs commence.

8. Completion of ossification in the lower epiphysis of fibula.

(B. PERIODS OF COALESCENCE AND COMPLETION.)

III. FROM THE 18TH TO THE 20TH YEARS.

1. Completion of the growth of the epiphyses of the "head" and of the "tubercle" of the ribs.

2. Coalescence of the head of the humerus (or arm-bone) with its shaft.

3. Coalescence of the lower epiphysis of the radius (a bone of the fore-arm) with the shaft.

4. Coalescence of the lower epiphysis of the ulna (a bone of the fore-arm) with its shaft.

5. Coalescence of the epiphyses of the metacarpal bones with their shafts.

6. Coalescence of the epiphyses of the phalanges with their shafts.

7. Coalescence of the head of the femur with its shaft.

8. Coalescence of the epiphysis of the great trochanter with the shaft of the femur.

9. Coalescence of the epiphyses of the condyles with the shaft of the femur.

10. Coalescence of the lower epiphysis of the tibia with its shaft.

11. Coalescence of the lower epiphysis of the fibula with its shaft.

IV. FROM THE 20TH TO THE 24TH YEAR.

1. Coalescence of the upper epiphysis of the tibia with its shaft.

2. Coalescence of the upper epiphysis of the fibula with its shaft.

3. The clavicle completes itself.

4. Coalescence of the occipital with the sphenoid bone.

5. Coalescence of the fourth with the third piece of the sternum (breast bone).

6. Coalescence of the bodies of the vertebræ with their epiphysal plates.

7. The wisdom-teeth appear in the cavity of the mouth.

8. The bones now become gradually thicker, the joints stronger, and the shoulders broader; the muscles firmer, better-developed, and more powerful.

V. FROM THE 25TH TO THE 30TH YEAR.

1. Completion of the vertebral column.

2. Completion of the sacrum.

3. Coalescence of the third with the second piece of the sternum, or breast-bone.

4. Completion of the ribs.

5. Coalescence of the haunch-bones with their crests.

After ossification seems complete in the "principal piece," or shaft of a bone, it still continues to grow in length, and to increase in girth, till perfect consolidation of all its portions

is eomplete. So long as it grows in length, a portion of soft, growing tissue intervenes between the "principal pieee" and those parts that are to be eompletely soldered on. When this is about to take place, the intervening soft tissue, which glues the parts together, is more freely supplied with blood for the purposes of growth; and the hitherto soft substanee being eonverted into bone, the "principal piece" eeases to elongate by growth in that direetion; the parts eoalesce by permanent bony union, and the bone is eonsolidated. From the record of the "events" in the growth of the bones already given at page 36, one may judge how long in point of time one end of a bone eontinues to elongate or grow in length eompared with its opposite end.

Thus the shoulder end of the arm-bone, or humerus, eontinues to grow towards the shoulder for two years at least after the elbow-joint end of that bone has eeased to grow.

Again, the wrist-joint ends of the bones of the fore-arm continue to increase in that direetion long after the growth towards the elbow-joint has ceased.

In the lower limbs the relations are the

reverse of this. The lower extremity of the thigh-bone continues to grow towards the knee-joint long after the bone has ceased to grow towards the hip-joint; while the upper ends of the principal pieces of the leg bones continue to grow towards the knee-joint for a considerable time after growth has ceased towards the ankle-joint.

A French physiologist has come to the same conclusions from experiments on animals;* and they are results of some consequence in connexion with excision of joints, and operations on the joints in young subjects.

For instance, excision of the elbow-joint in young persons may not be followed by so decided a shortening of the limb so long as growth continues towards the shoulder and wrist-joints, and when the portions removed are only the epiphysal pieces. Excision of the knee-joint, on the contrary, is more often followed by decided shortening of the limb, because at the knee-joint growth chiefly advances. For similar reasons excision of the shoulder-joint exposes to more shortening than excision of the hip-joint: and excision of the wrist-joint to more shorten-

* M. Ollier, in *Comptes Rendus*, vol. lii., No. 4.

ing of the arm than removal of the ankle-joint would to that of the leg.

From this account of the events in the growth of the skeleton one can readily understand how the results obtained by Mr. Danson, relative to height, and given at page 20, do not indicate a regularly progressive increase in height from the age of eighteen to thirty. For instance, he found that the average height of 185 men at the age of twenty-four was less than that of 200 men at twenty-three, and 100 men at twenty-six years of age gave a lower average height than 200 men at twenty-five years of age; while 100 men at thirty gave a lower average height than 95 men each twenty-nine years of age.*

Let me now fix your attention on the framework of the chest, for the organs contained in this cavity seem especially to suffer in the recruit and the young soldier; and, first of all, let me remark, that next to the inspiration of bad air, the imperfect or continuously-obstructed expansion of the chest tends more than any

* Danson on "Statistics relating to the Growth of the Human Body," in *Statis. Soc. Journal* for March, 1862, p. 24.

other cause we know of to bring about diseases of the lungs and heart. The influence of pressure upon the chest, in the unfinished condition of its bones, is therefore of vital importance, and demands our consideration.

As the twig is bent, so the branch will grow. I have shown you that till the twentieth year of life the ribs behind are still unfinished, soft at their joint ends, where resistance and motion occur, and where they are still growing. The breast-bone in front is in a similar condition. It is obvious therefore that continued pressure upon these parts from before and from behind must exercise a material influence in fixing the future form of the chest. The cartilages of the ribs in front and the breast-bone ought to have full freedom to rise upwards and advance forwards at every inspiration, for thus the diameter of the chest from before and behind is naturally increased at every act of breathing. Any pressure* on the chest, therefore, exerted between the front aspect and the back, when the bones are still growing, must *tend to set* the further growth of the bones in an unnatural

* Influence of pressure on the bones, see *Humphry on the Human Skeleton*, p. 48.

direction; for, in order to maintain the vital capacity of the lungs, the capacity of the chest cavity from side to side must come to be increased, at the expense of the capacity in the other and normal direction. The capacity of the lungs goes on increasing with age, and height, and growth, so that men from five feet to six feet high inspire from 174 to 262 cubic inches in a progressively ascending scale. The growth of the heart also goes on relatively to the growth of the body.

There is still another physiological consideration which demands our attention in connexion with the *physical growth* of the young soldier, —it is the growth of the bones and muscles in relation to each other.

From twenty to twenty-five the bones become gradually thicker, the joints stronger, the shoulders broader, the muscles firmer and better developed.

When you trace in young animals how this progressive growth is related to the muscles and the bones, you cannot fail to notice that the *development* and *growth* of *the bones* are in adaptation and fitness to the increasing power

and actions of the muscles. The bones of the limbs become larger and stronger at their muscular attachments as the muscles become stronger and more active. This is shown, not only in relation to the growth of the bones adapting themselves to the growth of the muscles, but if the muscles are paralysed, the bones waste as well as the muscles, by a progressive wasting, and no amount of passive motion will prevent the occurrence of this atrophy, or retard it.

Again, it has been shown by the accurate experiments of James Forbes, formerly Professor of Natural Philosophy in the University of Edinburgh, that the muscles undergo a gradually steady and progressive development as to strength as the age of the individual increases after puberty up to thirty years. From the observations also of Quetelet and of Forbes, it is known that by exercise of a well-regulated kind, a progressively greater amount of force can be got out of a man as his age increases, if his training is judiciously conducted, and his bodily condition maintained at the proper standard. According to Forbes—(*See Addenda II.* page 71).

	Pounds.
Englishmen, at the age of 20 to 25 give a tractile force of	366—384
Scotchmen, ditto, ditto	374—404
Irishmen, ditto, ditto	397—413

Looking, therefore, to the facts I have noticed regarding (1) age; (2) weight; (3) stature; (4) the development and growth of the skeleton, as recorded by the laborious and prolonged observations of painstaking anatomists; (5) the vital capacity of the chest, as known by experiment; (6) the co-relation of the growth of muscle with bone; and, lastly, the progressive increase of muscular force with ages from twenty to twenty-five; I think, gentlemen, that I have given you sufficiently cogent physiological reasons for saying that the physical training of recruits demands great circumspection and care. You can also appreciate the feelings of the first Napoleon, after the battle of Leipsic, when he said,—"I *must* have grown men: *boys* serve only to fill the hospitals and encumber the roadsides."

The selection of Recruits, also, to be judicious, implies a regard to the due concurrence of age, height, and development, as the basis of selection, and their future treatment in training

must be regulated accordingly. The earlier the age fixed upon as the *minimum* at which recruits may be taken, the period of probation required for careful and efficient training will require to be lengthened. It is better that age should be the qualification fixed at the *minimum*, for obvious physiological reasons; although it may be difficult to get an accurate record of it under the present inducements to enlist. *Height* therefore has rather been taken as a standard; and when men are much required for the service, the *minimum* of qualification, as regards height, is lowered, without any reference to age—obviously a physiological error. The following table, laid before the select committee of the Army before Sebastopol, shows the "Regulation standard of height," with the dates at which the standard was lowered.*

* For the sake of comparison let me add,—

I. Average height of *full-grown men* at 25 years of age, as given by the following observers:—

Quetelet,	5 feet 5·27 inches	=	65·27 inches.
Danson,	5 ,, 6·30 ,,	=	66·30 ,,
Boyd,	5 ,, 7 ,,	=	67· ,,
Liharžik,	5 ,, 8·898 ,,	=	68·898 ,,

II. Average height of the "*growing lad*" 18 years of age:—

Boyd,	5 feet 0· 5 inches	=	60· 5 inches.
Liharžik,	5 ,, 4·17 ,,	=	64·17 ,,
Danson,	5 ,, 4·34 ,,	=	64·34 ,,

CAVALRY.	Men.		Growing Lads.	
	Max.	Min.	Max.	Min.
	ft. in.	ft. in.	ft. in.	ft. in.
1st March, 1854—				
Heavy Cavalry	5·10	5·7	5·8	5·6½
Light Cavalry	5·9	5·7	5·7	5·6
Cavalry in India	5·9	5·6	—	—
24th March, 1854—				
Heavy Cavalry	5·9	5·6½	5·8	5·6
Light Cavalry	5·8	5·6½	5·7	5·6
27th April, 1854—				
Cavalry in India	5·8	5·6	—	—
30th October, 1854—				
Heavy Cavalry	5·9	5·5½	5·9	5·5½
Light Cavalry	5·8	5·5½	5·8	5·5½
Cavalry in India	5·8	5·5½	—	—
INFANTRY.				
1st March, 1854—				
General Service.....	—	5·5½	—	5·5½
Indian Service	—	5·5½	—	—
30th October, 1854—				
General Service.....	—	5·4½	—	5·4½
19th December	—	5·4	—	5·4
ROYAL ARTILLERY.				
Previous to July, 1854.....	—	5·7	—	—
21st July, 1854	—	5·6½	—	—
23rd October, 1854	—	5·6	—	—

With respect to this table, an obvious physiological mistake has been already taken notice of—namely, the undue or unnatural height of growing lads.

If *eighteen years* of age is to be the *minimum* fixed for the enlistment of "growing lads," then the *height* should be, as near as possible, 5 feet 4 inches, and the *weight*, as near as possible, 112 lbs. The *height* at eighteen years of age ought not to be *below* five feet two inches, and certainly not *below* five feet. At an age so young as eighteen a height *below the average* is apt to have been the result of defective feeding in early life, tending to a diminution of the normal rate of increase and growth of the body. Under such circumstances stunted development and diseased vital processes are the inevitable consequences. The constitutional tendencies of the future being are thus more or less certainly fixed at an early age: and although at the age of eighteen the recruit may have no evident disease, yet a *minimum* height and weight at that age will indicate a decided tendency to constitutional disease. On the other hand, also, as the height approaches a *maximum* at the age of eighteen, the excess of

growth of the body generally compared with the expansion, growth, and vital capacity of the lungs, becomes sufficiently obvious by the contrast of the tall body with the narrow and flat chest, in which the apices of the lungs approach close to each other. Generally in such cases the reparative organs are out of proportion to the body which has to be sustained.

Again, if the *height* of the soldier is the main qualification to be looked to in selecting the recruit, then the age must be in accordance. For example, if men five feet eleven inches or six feet are in demand, then the age of such men should be not less than twenty to twenty-five years, and the *weight* not less than 160 to 180 pounds. We know that there are limits to the rate of growth affixed to the constitution of each individual; and although men may vary as to height within certain physiological limits, the age being the same; yet the *height* of the recruit should never be more than the age justifies: and if a period of probation for training is duly regulated, and fully recognises

* Dr. E. Smith on Cyclical Changes of the Human Constitution, p. 288; also Liharžik's results, Addenda I., page 63.

physiological principles as its basis, (and which indeed cannot be disregarded with impunity) then the *age* at which the training commences is not of much moment, provided the *nature* of the training is suited to the years. But for the economy of the training system, the more normal the concurrence of age, height, weight and development that can be obtained, the better will be the result.

I have brought these topics before you, because the condition and the growth of the recruit and the young soldier naturally challenge our attention at the outset; and as an example of how you must take a broad and strictly physiological view of pathology, in order to "appreciate the causes and the nature of disease."

The result of an improper selection of "growing lads," and the injudicious exercises through which they are put, instead of training them according to well-ascertained physiological principles, tends in the first instance to encumber the military hospitals, and if the system does not lead to the premature death of the young soldier, he is sooner or later thrown out upon the civil population with one or more of

his vital organs damaged for the remainder of his life.

The serviee of such young soldiers, who are no sooner out of the hospital than they are in again, ean only be regarded as merely *nominal* serviee: and the "strength" of an army if eomposed of such material can never constitute a very formidable phalanx.

A period of probation for training is also absolutely neeessary in order to observe whether or not there are any circumstances in the every-day life of the man, indicative of the "constitutional state," under which "Phthisis" is likely to develop itself. Time is required to make sueh observations, and no better time can be set aside for this purpose, than a period of probation for the recruit. Surely it were much better that this be done with all, as a rule, before the ranks of the army are filled up by them indiscriminately, than that these ranks be filled up by those who, if not actually ill, are always in hospital, and whose eases appear in the reeords of disease under a designation hitherto so very peeuliar to our Army statistics, namely "*observatio.*"

By an order of the King signified to the

Secretary at War, of date, July 30th, 1830, it was ordained in the "Pensioning Warrant," that "Recruits under three years' service, who upon trial have been proved to be never likely to be made good and efficient soldiers, may be reported once a year after the summer half-yearly inspection, for the purpose of being discharged, under such instructions as the Commander-in-chief and the Secretary at War may issue." * Why not make this apply at the end of a fixed, uniform, and constant period of probation for the special training of every recruit?

The conditions under which the ranks of the Roman Army were recruited involved a lengthened period of probation for these recruits. Before a Roman conscript was finally approved, he underwent a probation of four months, for the purpose of ascertaining whether he was in all respects fit for military service. When at the end of that period, it was satisfactorily proved that he had sufficient activity and strength to enable him to surmount the hardships of a soldier's life, and if at the same time it appeared that he possessed the

* Marshall, loc. cit., p. 163.

requisite mental capacity, and a due degree of courage, the military mark was indelibly imprinted on his hand.*

We might still with profit return to the example shown us by the period of probation in the Roman army; and we still agree with the opinion expressed by Vegetius (who wrote so early as the fourth century), that "an army raised without proper regard to the choice of its recruits was never yet made a good army by length of service." He, too, warns us against the error of looking for great height among young soldiers, and it would appear from his statements that the *minimum* height of the young Roman soldier was not more than 62·9939 inches; and in our day the *minimum* height of the young French soldier for general infantry service is only 61·41855 inches, and for the light cavalry 65·75936 inches.†

* *United Service Journal*, June, 1830.

† See Vegetii Renati Flavii, "Opera de re Militari," Paris edit. of 1633; also, "Souvenirs d'un Médecin Militaire," par le Dr. Adolphe Armand. Paris, 1858.

NECESSITY OF SOUND METHODS OF OBSERVATION AND REASONING.

I would now, in conclusion, very briefly impress upon you at the outset of your official life, the advantage of convincing yourselves of the necessity of learning and following the "*soundest methods of observation and reasoning*" in that science which is your special vocation. You have already seen enough to appreciate the fact that the "sources of error in our observations are extremely numerous;" and the more closely you observe, and the more cogently you reason, the truth will perhaps become apparent, that "there are more false facts than false theories in our science." Care in observation, absolute accuracy, certainty and trustworthiness, are the essentials to be aimed at. Observations recorded without

regard to these essentials, are worse than useless.

If you look closely into the progress of pathology during the past twenty years, you will notice that it has made progress just in proportion as observations have improved in accuracy, in extent, and in the appreciation of their relation to physiological doctrines, not before recognised as of importance. Look, for instance, to the investigations regarding the condition of the urine in disease (so clearly expounded by Dr. Parkes*), in regard to which proper analyses were, up to a recent date, almost impossible. *At first*, the mere per-centage amounts of constituents were determined—a method which conveyed isolated and valueless results.

The next step in advance consisted in observations made and recorded as to the *absolute constituents excreted in a given time.* This was still insufficient to yield any practically useful result.

The third step in advance consisted in observing the fact that "*variations*" occurred from day to day—nay, from hour to hour, which re-

* "The Urine in Health and Disease." By Dr. E. A. Parkes.

quired to be considered, so that no conclusions are justifiable when merely taken from an analysis and observation of a single day.

Now, we recognise this truth, and find it necessary to refer to and compare the urinary excretions taken daily, and sometimes oftener, with the body-weight; while proper methods must be adopted for estimating these means, calculating the results, and coming to sound conclusions.

Next to the observation of facts, one of the most important duties which you will have to discharge concerns the *recording* of such facts, and the framing of reports based on your own observations and inquiry.

Looking, therefore, not alone to the great importance of our own science, but also chiefly to the aim and objects with which you are more immediately concerned in Military Medical Practice, it is especially desirable that some general agreement or understanding should be arrived at, which will fix or regulate the means, the instruments, and the methods by which uncertainty in the results of investigation may be diminished, and greater stability given to the science of pathology, and to the

measures which you may devise for the prevention of disease. You must reason for yourselves on many things; and to do so successfully, you must frame a guide and adopt principles which will lead you to a sound and independent judgment. The aim of such a guide is to extend to your investigations the same methods of observation and reasoning which are found to have been most efficient and successful in other departments of knowledge, not less liable to speculative doctrines than medicine, namely, astronomy, optics, chemistry, politics, and mechanics.

It will be my duty to point out as we advance, the characters which distinguish sound from unsound methods of observation; as well as to indicate the proper means and instruments of inquiry for the subjects which will come under our special notice.

It is impossible to define generally the characters of a sound method of inquiry in our science more clearly than has been done by Sir G. C. Lewis* in a science which has many characteristics in common with that of medicine,

* On the Methods of Observation and Reasoning in Politics. By Sir G. C. Lewis. London, 1852.

so far as modes of observation and inquiry are concerned.

The general characters of a sound method of inquiry are defined as follows :—

"1. A sound method directs all our efforts to the right end, and furnishes at the same time a compendious and well-contrived mechanism for the attainment of that end. Mental labour is thereby abridged; and any amount of industry or exertion expended on the investigation is more productive than if a similar amount of industry and exertion were to be expended in following an unsound method.

"2. A sound method of inquiry assists the mental faculties, while at the same time it guides and enlarges their operation. Nevertheless a method, however sound, is not alone sufficient, and it cannot supersede either natural ability nor practice. Natural ability, combined with attentive study, and with practical experience in the employment of a good method, are all necessary to enable a person to use a good method of inquiry with success.

"3. A good and sound method of investigation is also one which will define the degree of precision of which a subject admits. Thus it

prevents waste of labour in striving after an exactness which is not attainable, and at the same time it guards against the error of supposing that, because the truth cannot be expressed with rigorous accuracy, an approximation as close as possible to the truth ought not to be made. It is indeed the mark of an instructed mind, as distinguished from an incompetent judge, that the mind 'be satisfied with the amount of exactitude and demonstration which comports with the subject.'

"4. A sound method of inquiry aims at furnishing such rules as may serve to guide the observer and reasoner in the solution of all questions bearing on the nature, the prevention, and the cure of diseases."

Our work here is chiefly connected with two of the great departments into which the science of pathology is mapped out; namely,—

1. The observation and registration of facts in morbid anatomy connected with the diseases of soldiers.

2. The descriptive pathology of such diseases.

With regard to the first of these divisions, it is absolutely necessary that you should be

careful and accurate in recording the several illnesses of soldiers which may come under your notice, and with regard to the nomenclature used. All this is necessary in order that the Medical history of every soldier should be complete, from the time he enters the service to his death or his discharge. On this point an important suggestion has been made by A. Forteath, Esq., Surgeon of the Royal Dragoons, but so far as I am aware not hitherto acted upon, namely :—that every soldier should be furnished with a book, similar to his account book, in which each time he was admitted to or discharged from hospital, should be entered, along with columns for disease, when and where contracted, exciting cause, symptoms on admission, peculiar symptoms, treatment, result, duration. This book to be kept either in possession of the hospital serjeant, or troop or company serjeant, and to be produced each time the man reports himself sick. By this means the man's previous medical history would be seen at a glance, a great help to a medical officer, who has frequently great difficulty in arriving at the truth, especially on being newly appointed

to the regiment, and with men sent to general hospitals, or in invaliding.

To meet this end, a classification of diseases and a nosology or nomenclature, in conformity with that used by the Registrar-General for the returns of the civil population, has been ordained in future to be used in the army. To this nomenclature you are expected to conform; and although by some (and these not a few) it is held to be a premature attempt (scientifically) to arrange diseases into classes, yet I think some practical good has arisen, and will still arise out of this attempt. For myself, I accept such a nosology simply as a contrivance to aid us in giving the same name to similar conditions of disease; believing that a system of some kind is better than no system whatever, more especially if the defects of the system adopted are understood and explained.

Pathology is yet too young to base a general and scientific classification upon; but we have every reason to hope, that by the aid of chemistry and the microscope it will grow more rapidly than it has hitherto done. The mere enumeration of diseases has almost doubled since Cullen's "Nosology" was

written; while our knowledge of facts relating to disease has greatly more than doubled. Cullen's "Nosology" became effete and useless at last, under the pressure of increasing knowledge acquired and effected with resources very inferior to those we now possess, and far less extensive. So we must hope that the present statistical nosology in use will sooner fall into disrepute than even Cullen's did, because there is every reason to expect that pathological knowledge will extend more rapidly than it has hitherto done.

I do not believe, therefore, that systematic arrangements, if consistent with existing knowledge, ever cramp or hamper a man in carrying out scientific investigations; on the contrary, I believe it enables him to see more clearly in what direction his labour must be advanced, and demonstrates more forcibly than otherwise the deficiencies of his knowledge.

ADDENDA.

I. (*See page* 19.)—Since these pages went to press, I have seen a most valuable series of measurements demonstrating the "law of increase" in the growth of man, as determined by very extensive measurements taken by Dr. F. P. Liharžik, of Vienna, and published by the Imperial Royal Court and State Printing Office of the Austrian Government.

The results which Dr. Liharžik gives at the military ages between the eighteenth and twenty-fifth years of age, alone concern us here; and they are very valuable, inasmuch as they represent not only a gradual and normal increase, but such increase is shown to be in relation with *six fundamental dimensions,* so that the nearer the conditions of normal relationship of different parts of the body with these dimensions are

fulfilled, the more regular and healthy is likely to be the growth of the individual. Dr. Liharžik also published some observations in 1858, showing that certain deviations from these normal dimensions, especially as regards retarded development of the thorax, were sufficiently significant to be practically important in pathology, more particularly as indicating a tendency to tuberculosis, scrofulosis, or rickets.

The following are the six fundamental dimensions upon which an estimation of the stature of man in relation to age is based, being portions of his total length at various ages.

1. The length of the head from its vertex to the apex of the chin.

2. The length of the neck from the apex of the chin to the upper margin of the sternum.

3. The length of the sternum from its upper margin to the end of the xiphoid cartilage.

4. The distance of the xiphoid cartilage to the upper margin of the pubic symphysis, the navel dividing this distance into two equal parts.

5. The total length of the thigh and the leg.

6. The vertical elevation of the centre of the internal malleolus over the sole of the foot.

With these six fundamental dimensions, the girth of the body at various parts, and the horizontal dimensions of some parts, are to be compared, in order to determine whether or not the corporeal dimensions of an individual present the several proportions which are consistent with normal growth and development.

According to Dr. Liharžik, the normal increase of the stature of the human body is completed at the end of the twenty-fifth year. This coincides with what is demonstrated regarding the growth of the skeleton; for the height of a man is mainly determined by the growth that takes place in the shallow strata of cartilage connecting the shafts or principal pieces of the bones with their several superadded pieces; so that the height gained after the age of twenty-five is not generally appreciable, inasmuch as union between the parts which influence height is completed by that age.

It will also be seen by the following extract from the tables published by Dr. Laharžik, that the model height of a "growing lad" at 18 years of age, is 163 centimetres—equal to 64·174404 inches; and that the height of a

man who has completed his normal growth at his twenty-fifth year is 175 centimetres, equal to 68·89890 inches.*

The following table represents in numbers of centimetres the relative augmentations of increase at the ages from the completed eighteenth year to the completed twenty-fourth year, arranged in the following columns :—

I. Age at the end of the year stated.

II. Length of the neck.

III. Length of the head.

IV. Length of the sternum.

V. Distance between xiphoid cartilage and pubic symphysis. The navel ought to mark exactly the middle point of this line.

VI. The total length of the thigh and leg, measured from the horizontal level of the pubic symphysis vertically to the centre of the internal malleolus. The articulation of the knee ought to mark the division of this line into two equal parts ; and thus the thigh from the hip-joint to the knee ought to be equal to the length of the leg from the knee to the internal malleolus.

VII. The distance from the sole of the foot to the centre of malleolus.

(These complete the six fundamental dimensions, to be first determined.)

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* Ten centimetres being equal to 3·93708 inches.

VIII. Upper length of the body from the vertex of the head to the upper margin of the pubie symphysis.

IX. Lower length of the body from the upper margin of the pubie symphysis to the sole of the foot.

X. Total length from the vertex to the sole.

(The upper extremities being extended horizontally, the following measurements are then to be made.)

XI. Length of the elaviele. It ought to be equal in length to the open hand.

XII. Length of the fore-arm, from the middle of the elbow-joint to the carpal joint.

XIII. Length of the upper arm.

XIV. Distanee of the head of the humerus from the middle line of the body.

XV. Half the length of the body. The distanee between the tips of the middle finger of the one side to that of the other, (the arms being extended horizontally,) ought to be exaetly equal to the length of the whole body.

XVI. The half-breadth of the shoulders. It ought to be equal to the half-breadth of the hips, and to 1-10th of the length of the body.

XVII. The transverse diameter of the head.

XVIII. Antero-posterior diameter of the head.

XIX. Circumferenee of head (above the superciliary ridges).

XX. Girth of the ehest immediately above both nipples.

XXI. Diameter of thorax. It ought to be equal to the diameter of pelvis.

All these measurements must be taken while the body is stretched at rest on a horizontal solid plane (not on a bed); and measurement by centimetres is by far the most useful for comparison.

No recruit or soldier ever ought to be measured in the erect attitude. Men are able to raise or lower their stature to an appreciable extent, when erect, but not in the horizontal position. By not attending to this cardinal rule, serious mistakes (involving sometimes a money loss), have been known to occur.

Were a period of probation determined upon for the regulated systematic training of recruits, then such measurements as these could be carefully determined in the first instance, and recorded. They would yield information of a most valuable kind, as an aid in coming to a conclusion at the end of the term of probation, as to whether or not a man selected in the first instance, is or is not likely to prove a wholesome and efficient soldier. No medical officer can determine this with justice to himself or the service, in the short time which can be given to the physical examination of a recruit as at present conducted. A period of

probation for careful observation as well as for systematic training, is absolutely necessary in order to fill voids in the ranks efficiently and economically, by recruits selected from "growing lads."

As a rule, "*good little men*" will be found the most useful and efficient, and at the same time afford the largest field for selection in the first instance; and if the "lads" selected at 18 years of age reach, *when mature* (at the age of 25), the height of 68, or 68·8 inches, they will have attained the average height of human beings; with which it appears to me the military authorities ought to be satisfied. The height of the Duke of Wellington in his prime was 68 inches. Was ever man a better soldier?

In the London Industrial and Art International Exhibition for 1862, may be seen among the objects from Austria (Class 29) models and photographs of the human figure in three different aspects at all ages. They are admirably adapted to convey correct ideas about the normal progressive growth of man as determined by Dr. Liharžik, from whose observations the following table has been drawn up:—

Relative increase of different dimensions in the growth of Man from the ages of 18 *to* 25 *years.*
(Francis Liharžik, M.D.)

(Unit of Measure = One Centimetre.)

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII	XIX.	XX.	XXI.
Age to the completion of the year.	Length of the									Upper extremities being extended horizontally, length										
	Neck	Head.	Sternum.	Distance between xiphoid cartilage and pubic symphysis. The navel marks the middle distance.	Total length of thigh and leg.	Distance from sole of foot to centre of inner malleolus.	Distance from vertex of head to upper margin of pubic symphysis.	Distance from upper margin of pubic symphysis to sole of foot.	Total length from vertex of head to sole of foot.	Of clavicle.	Of fore arm.	Of upper arm.	From middle line of body to head of humerus.	Half length of body to be noted here.	Half the breadth of the shoulders.	Transverse diameter of head.	Antero-posterior diameter of head.	Circumference of head.	Girth of chest.	Diameter of thorax.
18	7	23	21	12 + 12	82	6	75	88	163	$19\frac{34}{12}$	$22\frac{22}{12}$	$29\frac{6}{12}$	10	$81\frac{6}{12}$	$16\frac{18}{12}$	$16\frac{5}{12}$	19	54	78	21
19	$7\frac{1}{12}$	$23\frac{1}{12}$	$21\frac{3}{12}$	$12\frac{2}{12} + 12\frac{2}{12}$	$82\frac{5}{12}$	$6\frac{6}{12}$	76	89	165	$19\frac{8}{12}$	$22\frac{12}{12}$	$29\frac{10}{12}$	$10\frac{1}{12}$	$82\frac{5}{12}$	$16\frac{23}{12}$	$16\frac{5}{12}$	$19\frac{4}{12}$	$54\frac{6}{12}$	$81\frac{6}{12}$	$21\frac{6}{12}$
20	$7\frac{1}{12}$	$23\frac{1}{12}$	$21\frac{4}{12}$	$12\frac{4}{12} + 12\frac{4}{12}$	83	7	77	90	167	20	$23\frac{2}{12}$	$30\frac{2}{12}$	$10\frac{2}{12}$	$83\frac{2}{12}$	$16\frac{24}{12}$	$16\frac{10}{12}$	$19\frac{8}{12}$	55	85	22
21	8	$23\frac{2}{12}$	$21\frac{5}{12}$	$12\frac{6}{12} + 12\frac{6}{12}$	$83\frac{5}{12}$	$7\frac{6}{12}$	78	91	169	$20\frac{1}{12}$	$23\frac{5}{12}$	$30\frac{6}{12}$	$10\frac{2}{12}$	$84\frac{1}{12}$	$16\frac{25}{12}$	17	20	$55\frac{5}{12}$	$88\frac{6}{12}$	$22\frac{6}{12}$
22	$8\frac{1}{12}$	$23\frac{1}{12}$	$21\frac{7}{12}$	$12\frac{8}{12} + 12\frac{8}{12}$	84	8	79	92	171	$20\frac{5}{12}$	$23\frac{10}{12}$	$30\frac{10}{12}$	$10\frac{4}{12}$	$85\frac{5}{12}$	$17\frac{2}{12}$	$17\frac{1}{12}$	$20\frac{1}{12}$	56	92	23
23	$8\frac{5}{12}$	$23\frac{11}{12}$	$21\frac{9}{12}$	$12\frac{10}{12} + 12\frac{10}{12}$	$84\frac{6}{12}$	$8\frac{5}{12}$	80	93	173	$20\frac{9}{12}$	$24\frac{5}{12}$	$31\frac{0}{12}$	$10\frac{5}{12}$	$86\frac{5}{12}$	$17\frac{5}{12}$	$17\frac{5}{12}$	$20\frac{8}{12}$	$56\frac{8}{12}$	$95\frac{5}{12}$	$23\frac{6}{12}$
24	9	24	22	13 + 13	85	9	81	94	175	21	$24\frac{6}{12}$	$31\frac{6}{12}$	$10\frac{6}{12}$	$87\frac{6}{12}$	$17\frac{6}{12}$	$17\frac{6}{12}$	21	57	99	24

Addenda II.—[*See page* 44.]

The experiments of James Forbes (now Principal of the University of St. Andrew's) were made upon students in the university of Edinburgh, when he was Professor of Natural Philosophy there. The students experimented upon were upwards of 800 individuals, between the ages of fourteen and twenty-five, and illustrated clearly the law of physical development with age. Natives of Scotland, England, and Ireland were distinguished. The weights were expressed in pounds, including clothes; the height in inches, including shoes; strength was determined in pounds by Regnier's dynamometer. Compared with the observations of Quetelet, the progress towards maturity in Britain seemed greater in the earlier years (fourteen to seventeen) than in Belgium, and slower after-

wards. This result was more strongly indicated among the English than among the Scotch.

The superior physical development of natives of this country above the Belgians is very obviously marked. In *strength* it is greatest (one-fifth of the whole) ; in *height* it is least.

So far as the experiments on the English compared with the Irish can be considered as correct, they indicate that the English are the least developed of the natives of Britain at a given age, while the Irish are the most developed, the Scotch retaining an intermediate place.

The *maximum* height is barely attained at the age of twenty-five.

All the developments were found to increase between fourteen and twenty-six years of age; and all of them were found to increase more slowly as age increased.*

* Proceedings of the Royal Society of Edinburgh. January 16th, 1837.

London : Benjamin Pardon, Printer, Paternoster-row